

## CLAIMS

1. A catalyst used for steam reforming of methanol: comprising Al alloy particles each having an oxide surface layer containing fine copper oxide particles, the Al alloy particles being produced by a process comprising the step of performing leaching treatment for Al alloy particles with an aqueous alkaline solution which are prepared by pulverizing a bulky Al alloy having a quasicrystalline phase or a related crystalline phase thereof, the quasicrystalline phase being represented by the formula:  $\text{Al}_{100-y-z}\text{Cu}_y\text{TM}_z$  (where y is in the range of 10 to 30 atomic percent, z is in the range of 5 to 20 atomic percent, and TM indicates at least one of transition metals other than Cu), wherein the oxide surface layer containing fine copper oxide particles is formed by adjusting leaching conditions of the leaching treatment so as to form an oxide surface layer, which contains dispersed fine Cu particles and which is composed of an Al oxide and a transition metal oxide, on the surface of each of the Al alloy particles, followed by heat treatment of the leached Al alloy particles in an oxidizing atmosphere, whereby some or all of the fine Cu particles contained in the oxide surface layer are converted into the fine copper oxide particles.

2. The catalyst used for steam reforming of methanol, according to Claim 1, wherein the copper oxide in the surface oxide layer obtained by the heat treatment in an oxidizing atmosphere after the leaching treatment is CuO or a  $\text{Cu}(\text{TM}_x\text{Al}_{1-x})_2\text{O}_4$  ( $0 < x \leq 1.0$ ) spinel compound.

3. The catalyst used for steam reforming of methanol, according to Claim 1 or 2, wherein, in the surface oxide layer obtained by the heat treatment in an oxidizing atmosphere after the leaching treatment, an integrated layer composed of a Cu oxide and a transition metal (TM) oxide is formed in the vicinity of the interface with each of the Al alloy particles.

4. The catalyst used for steam reforming of methanol, according to Claim 1 or 2, wherein the TM is at least one element selected from the group consisting of Fe, Ru, Os, Co, Rh, and Ir.

5. The catalyst used for steam reforming of methanol, according to Claim 1 or 2, wherein the TM is at least one element selected from the group consisting of Mn, Re, Cr, Mo, W, V, Nb, and Ta.

6. A catalyst used for steam reforming of methanol,

comprising a surface layer having a structure in which Cu nanoparticles having a particle diameter of 10 nm or less are surrounded by  $\text{Fe}_3\text{O}_4$ ,  $\text{Al}_2\text{O}_3$ , or a mixture thereof, wherein the Cu nanoparticles are formed by reducing the CuO or the  $\text{Cu}(\text{TM}_x\text{Al}_{1-x})_2\text{O}_4$  ( $0 < x \leq 1.0$ ) spinel compound, according to Claim 2.

7. A method for manufacturing a catalyst used for steam reforming of methanol: comprising the steps of pulverizing a bulky Al alloy having a quasicrystalline phase or a related crystalline phase thereof, the quasicrystalline phase being represented by the formula:  $\text{Al}_{100-y-z}\text{Cu}_y\text{TM}_z$  (where y is in the range of 10 to 30 atomic percent, z is in the range of 5 to 20 atomic percent, and TM indicates at least one of transition metals other than Cu), and performing leaching treatment for Al alloy particles formed in the pulverizing step with an aqueous alkaline solution, wherein leaching conditions of the leaching treatment are adjusted to form oxide surface layers, which contain fine Cu particles dispersed therein and which are composed of an Al oxide and a transition metal oxide, on surfaces of the Al alloy particles, followed by heat treatment of the leached Al alloy particles in an oxidizing atmosphere so that some or all of the fine Cu particles are converted into fine copper oxide particles, whereby the catalyst used for steam reforming of methanol is manufactured so as to have Al alloy

particles provided with oxide surface layers containing the fine copper oxide particles.

8. The method for manufacturing a catalyst used for steam reforming of methanol, according to Claim 7, wherein the copper oxide in the surface oxide layers obtained by the heat treatment in an oxidizing atmosphere after the leaching treatment is  $\text{CuO}$  or a  $\text{Cu}(\text{TM}_x\text{Al}_{1-x})_2\text{O}_4$  ( $0 < x \leq 1.0$ ) spinel compound.

9. The method for manufacturing a catalyst used for steam reforming of methanol, according to Claim 7, wherein the temperature of the aqueous alkaline solution is in the range of 40 to 90°C.

10. The method for manufacturing a catalyst used for steam reforming of methanol, according to Claim 7, wherein the aqueous alkaline solution is an aqueous solution containing one of sodium hydroxide ( $\text{NaOH}$ ), sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), and sodium hydrogen carbonate ( $\text{NaHCO}_3$ ), the concentration thereof being in the range of 2 to 15 percent by weight.

11. The method for manufacturing a catalyst used for steam reforming of methanol, according to Claim 7, wherein an amount leached out of the Al alloy particles by the

leaching treatment using the aqueous alkaline solution is in the range of 0.5 to 40 percent by weight.

12. A method for manufacturing a catalyst used for steam reforming of methanol, comprising the step of reducing the CuO or the  $\text{Cu}(\text{TM}_x\text{Al}_{1-x})_2\text{O}_4$  ( $0 < x \leq 1.0$ ) spinel compound, according to Claim 8, so that a surface layer is formed having a structure in which Cu nanoparticles having a particle diameter of 10 nm or less are surrounded by  $\text{Fe}_3\text{O}_4$ ,  $\text{Al}_2\text{O}_3$ , or a mixture thereof.